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Trace gas dates Universe's first stars

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A giant cloud containing carbon monoxide has been spied in the most distant known galaxy in the Universe.

Light from the galaxy was emitted when the Universe was just a sixteenth of its current age. Astronomers say the traces of gas prove that star formation got started astonishingly quickly in the young Universe.

"The presence of carbon monoxide is very interesting because carbon and oxygen first need to form in stars of some sort, then be expelled by explosions," says team leader Fabian Walter of the National Radio Astronomy Observatory in Socorro, New Mexico.

The most distant known galaxy in the Universe is a "quasar" called J1148+5251, which contains a black hole at least a billion times heavier than the Sun. It shines so brightly because material being dragged inwards by the hole's powerful gravitational field gets heated to enormous temperatures.

Ballooning fireball

Earlier in 2003, astronomers discovered that the quasar lies so far away that its light has taken 12.8 billion years to reach the Earth. In other words, astronomers are seeing the galaxy as it was 12.8 billion years ago, only 870 million years after the Universe was born in the Big Bang.

The only elements created in the ballooning Big Bang fireball were hydrogen and helium. At some later point, galaxies of stars started to form. Nuclear reactions in the stars would have churned out heavier elements like carbon, nitrogen and oxygen.

Now Walter's team has seen the spectral fingerprint of carbon monoxide in J1148+5251, which they studied using radio telescope arrays in New Mexico and the French Alps.

For this gas to be present so early in the Universe's life, a generation of stars must have already lived and died in explosions that littered heavy elements across space.

Given typical stellar lifetimes, astronomers estimate that the stars would have started forming about 650 million years after the Big Bang, then exploded during the following 200 million years. Carbon and oxygen from the exploded stars would then have cooled and bonded to form carbon monoxide.

Very young, very big

The observations also suggest the quasar contains a reservoir of cool molecular hydrogen 20 billion times more massive than the Sun. This would provide plentiful raw materials for building more stars.

Astronomers had assumed that such massive congregations of material only built up after long periods of slow mergers between small galaxies. But the huge mass of material in J1148+5251 suggests that just 870 million years after the Big Bang, it was already as heavy as the big galaxies seen today.

"It's so surprising to see such a massive galaxy so early in the Universe," says Walter, who now hopes to find out how it got so monstrous so quickly.

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